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GB 1419066 GB 0383229
GB 1290548

(58) Field of search
B5A

(54) Adjusting the shape of a thermoplastics orthotic or prosthetic device

(57) In a method of modifying a thermoplastics orthotic or prosthetic device, e.g. an artificial limb socket 1, a portion of the socket is first held against an (electrically) heated mandrel 4 and in a stream of heated air supplied from a nozzle 3 adjacent the mandrel 4 to increase the flexibility of the material of the socket in the region to be modified. When the material is sufficiently flexible, the socket 1 is transferred to a former 6 and worked against the former until the region to be modified is of a required shape, whereupon a stream of cold air is directed at the modified region to preserve the required shape, the socket being held against the former during cooling.

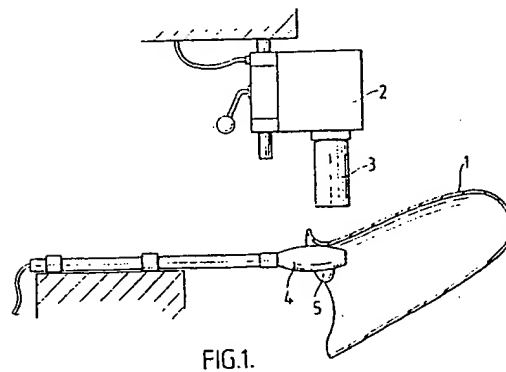


FIG.1.

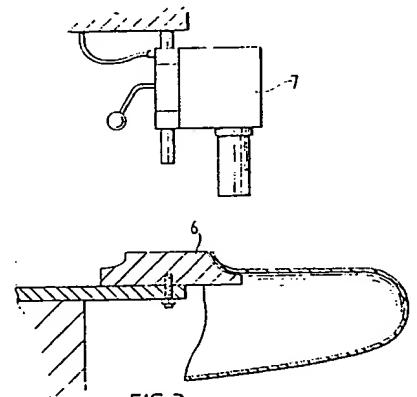
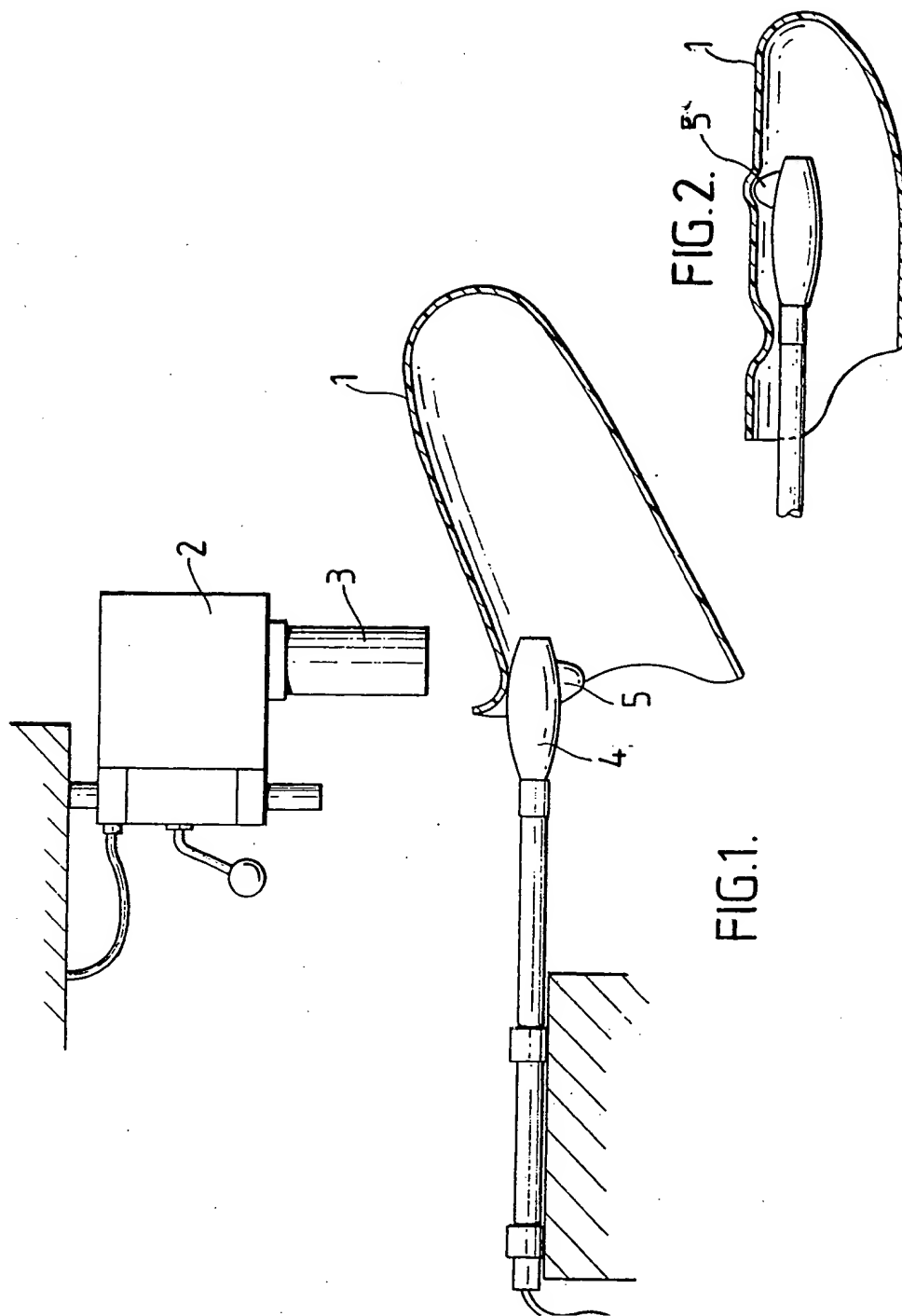


FIG.3.

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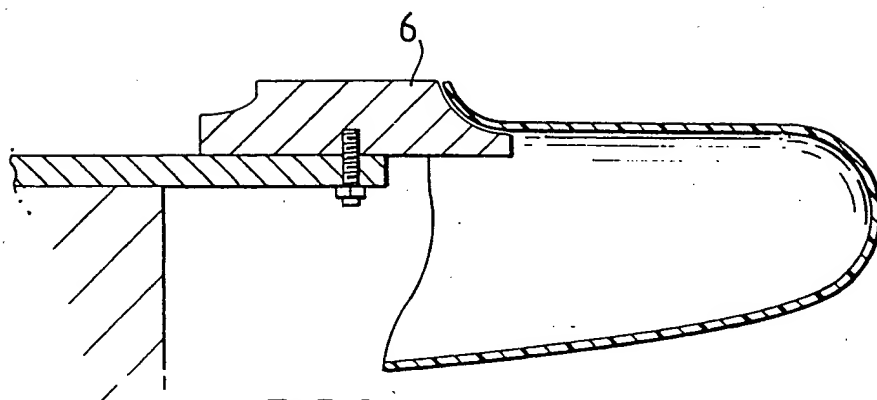
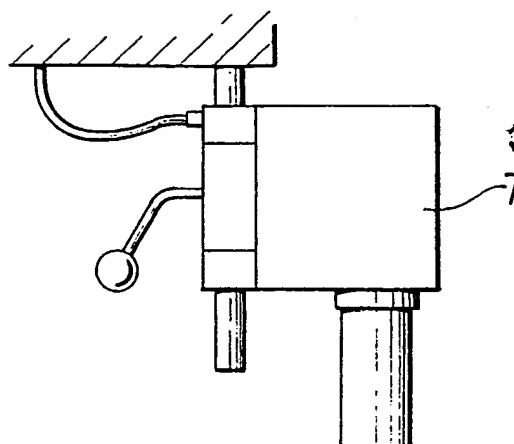


FIG.3.

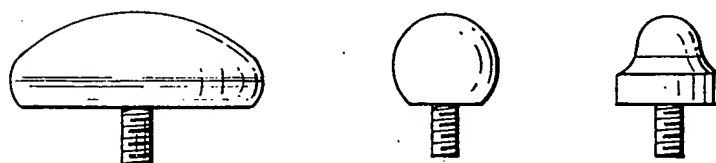
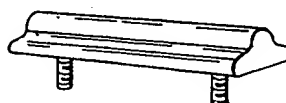


FIG.4.



SPECIFICATION

Adjusting an orthotic or prosthetic device

5 This invention relates to the post-shaping or adjustment of a thermoplastics orthotic or prosthetic device such as an artificial limb socket.

10 Increasingly, artificial limb sockets are being produced from thermoplastics material. The principal steps in producing a socket are the preparation of a mould typically by the casting of a plaster impression of the patient's stump, the heating of a sheet of thermoplastics material such as a copolymer of ethylene and propylene, and the combined
15 drawing down and vacuum forming of the heated sheet over the mould or the plaster impression. The socket is then trimmed, and outer limb components attached to it ready for fitting to the patient.

20 Thermoplastics sockets made in this way are gradually replacing hand-worked metal sockets. However, an advantage of metal sockets is that it is a comparatively simple operation to modify the shape of the socket at the fitting stage by additional working of the metal to relieve pressure points.

It is an object of this invention to provide a method of altering the shape of a thermoplastics socket at the fitting stage.

30 According to this invention there is provided a method of modifying the shape of a thermoplastics orthotic or prosthetic device, in which the device is held in contact with a heated surface and in a stream of heated air to reduce the rigidity of the material in a selected region and to allow the
35 shape of the device in that region to be modified, and in which, following modification of the shape, a stream of cooling air is directed at the said region while the device is held against a support to preserve the modified shape.

The invention is particularly applicable to the adjustment of a thermoplastics artificial limb socket.

To assist in modifying the shape of the device in the region to be altered, the device, having been
45 heated to a required temperature, may be applied to and worked against a suitably shaped former, the same former then being used as the support so that the material is held in the modified form while it is being cooled.

50 The invention will now be described by way of example with reference to the drawings in which:
Figure 1 is a side view of apparatus for heating a portion of a thermoplastics artificial limb socket;

Figure 2 is a side view of a part of the apparatus of *Figure 1* showing how a localised area of the socket can be heated;

Figure 3 is a partly sectioned side view of apparatus for use in working the material of the socket and for cooling the socket; and

60 *Figure 4* is a group of views showing formers of different shapes for use in working the material of the socket.

Referring to *Figure 1*, for heating the material of

electrically heated mandrel 4. The socket is held with the region to be modified in contact with the mandrel and beneath the nozzle 3 to heat the region to be modified uniformly on both sides.

70 In the example, the adductor region of an above-knee artificial leg socket is being adjusted. The mandrel 4 also has a 'button' 5 for use when only a very localised, sharply defined relief adjustment is required, as shown in *Figure 2*. When the material in the adjustment region has reached a sufficient state of flexibility the socket 1 is transferred to a wooden former 6 of a suitable shape (as shown in *Figure 3*) against which it is 'worked' to stretch the material to the required shape. As soon
80 as this point has been reached, a second blower 7 is switched on to cool the socket material and harden it while the modified region is held in position on the former. Operation of the blower 7 from a foot switch allows the user to hold the socket in the required position with both hands.

The former 6 has an outer concave section which is useful for adjustments in the adductor region. Other wooden formers of different shapes are shown in *Figure 4*.

90 The temperature of the mandrel, and that of the air directed onto the socket 1 from the blower 2 are set so as to heat the material of the socket in the adjustment region to approximately 145°C. At this temperature, a material such as an Isotactic Copolymer of 7 ethylene/propylene (MFI 0.3) is moderately elastic or "flexible". In this state the material, if deflected from its initial shape and then released, will return to approximately the initial shape. Its transparency in this state is also largely unchanged. If the material is overheated, it becomes "rubbery" or "soft". In this latter state, typically at 180°C, the material will not return to its original shape after deflection. It also becomes relatively transparent, oxidation and degradation take place, and it becomes somewhat brittle on cooling. Other materials can be treated in this way, such as LDPE (low density polyethylene), PP (polypropylene homopolymer), HDPE (high density polyethylene), PVC (polyvinylchloride), and others, although the required temperature varies from material to material.

CLAIMS

115 1. A method of modifying the shape of a thermoplastics orthotic or prosthetic device, in which the device is held in contact with a heated surface and in a stream of heated air to reduce the rigidity of the material in a selected region and to allow
120 the shape of the device in that region to be modified, and in which, following modification of the shape, a stream of cooling air is directed at the said region while the device is held against a support to preserve the modified shape.

125 2. A method according to claim 1, wherein the device is a thermoplastics limb socket.

3. A method according to claim 1 or claim 2, wherein the shape of the device in the said region is modified by working the material of the device

has been reached, and wherein the device is then held in contact with the former or one of the formers while the modified region is cooled.

4. A method according to any preceding claim, wherein the material of the device in the region to be modified is heated to a temperature at which it becomes flexible but not to a temperature at which it becomes soft or rubbery.

5. A method according to any preceding claim, wherein the material of the device in the region to be modified is heated to a temperature at which it becomes flexible substantially without an increase in transparency.

6. A method according to claim 4 or claim 5 wherein the material in the region to be modified is heated to a temperature in the range 140°C to 160°C.

7. A method according to any preceding claim, wherein the heated surface is convex and has a radius of curvature in one plane which is less than the minimum radius of curvature of the socket in the region to be modified.

8. A method according to claim 7, wherein the heated surface is the outer surface of an electrically heated mandrel.

9. A method according to claim 8, wherein the mandrel has a projection defining a second heated surface with a smaller radius of curvature than the remaining operative portion of the outer surface of the mandrel.

10. A method according to any preceding claim, wherein the stream of heated air is directed onto one surface of the material to be modified whilst the opposite surface of the material is held against the heated surface, the heated air being supplied from a nozzle adjacent the heated surface.

11. A method according to any preceding claim, wherein the heated material is worked by manually pressing the material against the former and moving the socket to produce the required shape.

12. A method according to any preceding claim, wherein the former has a concave outer surface portion.

13. A method according to any of claims 1 to 11, wherein the former has a convex outer surface portion.

14. A method according to any preceding claim, wherein the cooling air is supplied from a nozzle adjacent the former.

15. A method according to any preceding claim, wherein the cooling air is provided from a blower operated by a foot control.

16. A method of modifying the shape of a thermoplastics orthotic or prosthetic device, wherein the device is held in contact with a heated surface and in a stream of heated air so that the material of the device in a region to be modified is made flexible, and wherein the device is then urged against a former to modify the shape of the device in the said region, the material being cooled whilst the device is held against the former or other support to preserve the required shape.

17. A method of modifying the shape of a thermoplastics artificial limb socket, the method being substantially as herein described with reference to

the drawings.

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